

REMARKS

The claims are 11 to 18 and 29 to 37 with claims 11 to 18 being withdrawn from consideration.

Claim 29 to 35 have been rejected.

The above amendment to claim 29 is responsive to the rejections under 35 U.S.C. 112 as indefinite.

Regarding item b), the Examiner's suggestions have been included in the above amendment.

Further, in claim 29, line 4, the term "the purifying section" has been changed to "a purifying section" to provide proper antecedent basis.

Regarding new claim 36, support is evident from page 6, line 25 to page 7, line 6 of the present specification.

Regarding new claim 37, support is evident from page 8, line 16 to 17 of the present specification.

Claims 29-31 and 33-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horlenko (4,301,298) with or without JP 10204030.

This rejection is respectfully traversed.

1. The present invention

A brief discussion of the present invention will be of assistance in appreciating applicants' reasons for traversal of the rejection.

As discussed in the previous response, in an easily polymerizable compound purification system employing a purification section which includes a distillation column and a condenser and a vacuum section capable of reducing pressure in the purification section, it is impossible to completely prevent the gas containing the easily polymerizable compound from flowing into the vacuum section from the purification section. If the easily polymerizable compound, which flows into the vacuum section, polymerizes in the vacuum section, the resultant polymer clogs the condenser. As a result, the vacuum section is frequently forced to stop (page 4, lines 2 to 4). In view of the above problems, the present invention focuses on inhibiting the polymerization of the easily polymerizable compound in the vacuum section.

2. Horlenko

In a conventional process for producing ethyl acrylate where the distillation is accomplished under vacuum, liquid seal fluid is employed for the vacuum pump to obtain the vacuum. Within the vacuum pump, the gaseous stream and the liquid seal fluid are intimately contacted with each other and are then discharged in a single stream as a gas-liquid mixture (column 1, lines 20 to 39)

In many instances, the recovery of the liquid seal fluid from the gas-liquid mixture is relatively easily accomplished by use of a simple separator, however in the production of ethyl acrylate, many problems occur because of the nature of the gaseous light ends stream. More particularly, various components of the light ends stream are absorbed or partially absorbed into the liquid seal fluid and removal of these components cannot be accomplished merely through the use of a separator.

In such instances, it is known to utilize distillation to separate absorbed components from the liquid seal fluid. Thus, the choice of a liquid to be utilized to provide the liquid seal in the vacuum pump is quite important since various problems in the recovery and recycle of the liquid seal fluid can be eliminated or minimized by selection of the proper liquid. Many liquids have been found not to be suitable because of polymerization, foaming and other problems. It is believed that some of these problems can, at least in part, be attributed to the presence of the sulfur dioxide in the gaseous light ends. (column 1, lines 40 to 60)

Horlenko's invention has been achieved in view of these problems, and an object of Horlenko is the use of a liquid which performs satisfactorily as a liquid seal fluid for a vacuum pump utilized in the recovery of light ends from the ethyl acrylate process. It is another object of Horlenko to provide an improved process for recovering the light ends stream from the said ethyl acrylate process and provide for recovery of the liquid seal fluid utilized in the vacuum pump providing the reduced pressure for the vacuum distillation system of the ethyl acrylate process. (column 1, line 61 to column 2, line 3).

Horlenko's process is for the production of ethyl acrylate by the reaction of ethylene with acrylic acid in the presence of a sulfuric acid catalyst, wherein, the reaction products are distilled in a vacuum distillation system at a reduced pressure less than atmospheric to obtain a liquid ethyl

acrylate and also resulting in a first gaseous light ends stream, which first gaseous light ends stream passes through a vacuum pump providing the reduced pressure for said vacuum distillation system.

Said vacuum pump utilizes a liquid seal fluid to provide a liquid seal therein and in said vacuum pump, said first gaseous light ends stream mixes with and is partially absorbed in said liquid seal fluid to result in a gas-liquid mixture which is discharged from said vacuum pump. Said gas-liquid mixture so discharged is fractionated to recover a liquid recycle stream comprising liquid seal fluid and which liquid recycle stream is recycled to said vacuum pump (column 2, lines 8 to 30).

In addition, Horlenko's invention resides in the use of, and the discovery that the use of, a normally liquid hydrocarbon having certain characteristics will serve as and provide good performance as a liquid seal fluid in a vacuum pump used to provide the reduced pressure in the above described vacuum distillation system for recovery of light ends in the ethyl acrylate process. (column 2, lines 39 to 45).

3. JP 10-204030

JP10-204030 relates to a process for purifying and producing (meth)acrylic ester, and an apparatus therefor. In this process, the pressure in distillation system is reduced by the use of a steam ejector, and the steam ejector may have two to five stages.

4. Unobviousness

a. The rejection states that "Horlenko did not mention an ejector. However, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to add a steam ejector in the process of Horlenko, in the manner as taught by JP'030."

This assessment is untenable.

Firstly, as explained above, Horlenko focuses on the choice of liquid seal fluid in a vacuum distillation of ethyl acrylate and Horlenko's invention resides in the use of a normally liquid hydrocarbon having certain characteristic as such liquid seal fluid. (column 2, lines 39 to 45). Thus, it is hindsight to remove the vacuum pump using a liquid seal fluid from Horlenko and apply or add the steam ejector as taught in JP10-204030, thereby reconstructing the present invention with the benefit of applicants' own disclosure.

Secondly, it should be noted that the steam ejector used in the present invention employs steam to vacuum the purifying system, while the vacuum pump disclosed in Horlenko uses the liquid

seal fluid. This difference makes it difficult to apply the steam ejector to the system of Horlenko. For example, even if the steam ejector is applied to Horlenko in place of the vacuum pump using the liquid seal fluid, it is not disclosed how the liquid containing the polymerization inhibitor is used. Since JP10-204030 fails to use the polymerization inhibitor in the vacuum section, there is no suggestion and motivation to supply the liquid containing the polymerization inhibitor in the vacuum section.

b. The separator in Horlenko should be distinguished from the gas and a liquid contact chamber in the present invention.

In Horlenko, the gas-liquid mixture which is produced by the vacuum pump is passed to the separator. This separator is used to separate the gas-liquid mixture into the gas phase and the liquid phase, while the gas and contact chamber is used to contact the gas containing easily polymerizable compound and the liquid containing the polymerization inhibitor to produce the condensate containing the easily polymerizable compound and the polymerization inhibitor. Thus, the separator in Horlenko should be distinguished from the gas and liquid contact chamber in the function thereof.

c. Further, although the specification of Horlenko was carefully checked, "condensing the resulting distilled compound in the condenser after the distilling the easily polymerizable compound in the distillation column" is not explicitly disclosed in Horlenko.

Horlenko merely discloses "the reaction products are distilled in a vacuum distillation system at a reduced pressure less than atmospheric to obtain a liquid ethyl acrylate product and also resulting in a first gaseous light ends stream from said vacuum distillation system containing sulfur dioxide..., which said first gaseous light ends stream passes through a vacuum pump providing the reduced pressure for said vacuum distillation system..." (column 2, lines 13 to 22).

Further, if one takes into consideration that the recycle stream contains a relatively large amount (about 20 % to less than 40 %) of ethyl acrylate (column 4, lines 17 to 22), it should be understood that the first gaseous light ends stream is directly drawn into the vacuum pump in Horlenko.

Since the first gaseous light ends stream is not at all subject to the condensation in Horlenko, Horlenko is completely unsuggestive of the present invention which approaches the problem caused by the gas containing the easily polymerizable compound, which escapes from being condensed in the condenser next to the distillation column in the purifying section.

d. Further, even if the steam ejector is added to the process of Horlenko, the requirement of claim 29 of “permitting an exhaust gas containing the easily polymerizable compound which is not condensed through the condenser, to flow into the gas and liquid contact chamber through said steam ejector in the vacuum section” is not satisfied or suggested.

For example, in the case where the steam ejector is added between the vacuum pump and the ethyl acrylate process, the gas containing the easily polymerizable compound flows into the vacuum pump through the steam ejector, not the gas and liquid contact chamber. In the case that the steam ejector is added between the vacuum pump and the separator, the discharged gas and liquid mixture from the vacuum pump passes through the steam ejector in place of the exhaust gas from the condenser. Further, it is not necessary to add the steam ejector in line with the vacuum pump.

As is apparent from the above discussion, the present claims are not obvious from Horlenko with or without JP 10-204030.

5. With regard to the rejection of claim 32 as being unpatentable over Horlenko with JP 10204030 as applied to claims 29-31 and 33-35 above, and further in view of Nezu, the present invention is not obvious over Horlenko with or without JP 10-204303 as stated above and dependent claim 32 is also not obvious over Horlenko with or without JP 10-204030, further in view of Nezu, as will now be explained.

6. Nezu

Nezu relates to a method and apparatus for distilling a readily polymerizable liquid such as readily polymerizable monomers without causing the formation of an undesirable polymerization product. The condenser disclosed in Nezu should be distinguished from the gas and liquid contact chamber in the present invention. The condenser in Nezu is directly connected to the distillation column (column 3, line 39-43). Accordingly, the condenser in Nezu corresponds to the condenser of the purifying section in the present invention, while the gas and liquid contact chamber is in the vacuum section. Although a polymerization inhibitor is added into the condenser in Nezu, the inhibitor merely inhibits the polymerization in the purifying section, not the vacuum section as called for by the present claims.

For the foregoing reasons, it is apparent that the rejections on prior art are untenable and should be withdrawn.


No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

Respectfully submitted,

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